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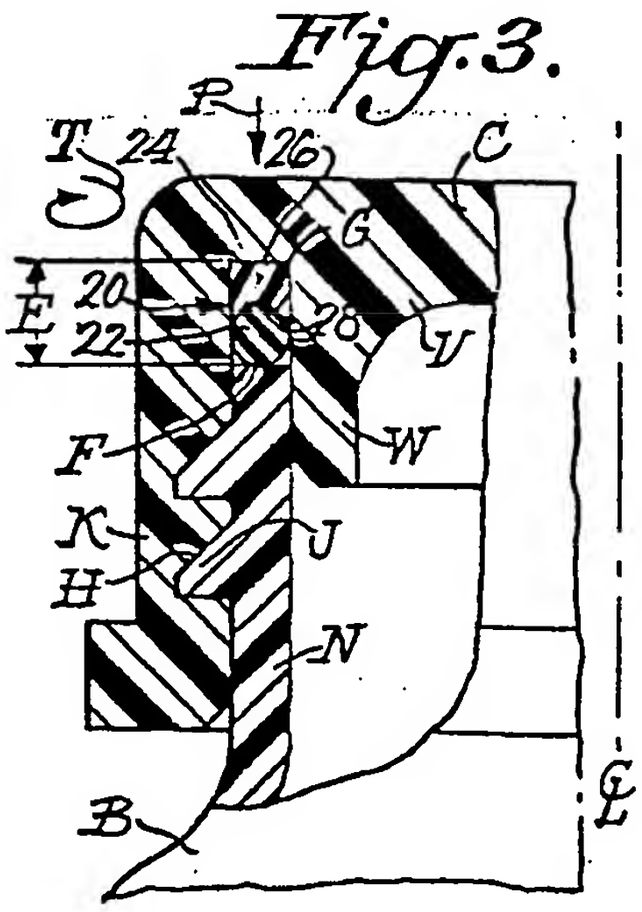
(54) Seal assembly for a centrifuge bottle.

(57) A seal assembly for a centrifuge bottle includes an annular seal ring and an annular slip ring disposed in stacked relationship with respect to each other. The slip ring is slidable along an interface defined between the slip ring and a surface on the bottle cap. In this way the generation of a circumferentially directed restoring force on the seal ring as the bottle cap is threaded onto the bottle is avoided.

Fig. 3.



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TITLE IP-0397

SEAL ASSEMBLY FOR A CENTRIFUGE BOTTLE

FIELD OF THE INVENTION

This invention relates to a seal assembly for a bottle and, in particular, to a seal assembly for a bottle of the type used to carry a sample during centrifugation.

BACKGROUND OF THE INVENTION

It is common practice to utilize bottles to carry samples of material during centrifugation. Such centrifuge bottles are available in a wide variety of common shapes and volumes. Typical of such bottles are wide mouth bottles such as those sold by E. I. du Pont de Nemours and Company, Inc. under the trademark Sorvall®. These bottles are typically provided with threads either on the upper exterior or interior portions of the bottle's neck. The threads are adapted to receive conforming threads provided on the appropriate surface of a generally inverted cup-shaped cap. Sealed integrity between the upper end of the bottle and the cap is effected by the provision of an annular seal ring, typically an O-ring seal formed from an elastomeric material, disposed in a seal chamber defined between the upper end surface of the bottle and the base surface of an annular groove formed in the undersurface of the cap. In practice, the groove may be molded into the material of the cap or otherwise defined by the cooperative association of the cap's shell and a plug receivable into the shell.

Figure 1 illustrates an elevational view entirely in section of a portion of the typical seal arrangement available in the prior art with a portion of the bottle and cap broken away. The structure shown is symmetrical about the centerline CL of the bottle B and cap C. As noted, the undersurface U of

the cap C has formed therein an annular groove G which cooperates with the upper end surface F of the neck N of the bottle B to define an enclosed annular seal chamber E adapted to receive a seal member S. The groove G is defined by an annular flange K and a concentric inner wall W. Typically, the inner surface of the flange K has threads H thereon. The neck N of the bottle B has corresponding threads J thereon. When the cap C is threaded onto the neck N of the bottle B compressive force in the direction P acts to compress the seal S between the cap C and the upper end surface of the neck N to effect a seal and inhibit leakage of sample from the interior of the bottle B.

It has been observed, however, that as the cap C is threaded onto the bottle in a conventional right-hand threading direction illustrated by the arrow T, a frictional force is generated at the interface I between the O-ring seal S and the base of the groove G in the bottle cap C. This frictional force has a tendency to generate in the seal ring a restoring force acting in the direction of the counter arrow R shown in Figure 1. The restoring force R acts on the cap C in an uncapping direction. As a result the bottle cap C to urge the same has a tendency to "back up" slightly even after the cap C has ostensibly been fully threaded onto the neck N of the bottle B.

This back-up of the cap C with respect to the bottle B generated by the action of the restoring force imposed on the O-ring seal member is believed disadvantageous in that it diminishes the magnitude of the compressive force p, thus lessening the extent of sealed integrity between the bottle and the cap. Consequently the possibility of leakage of sample from the interior of the bottle is increased.

Accordingly, in view of the foregoing, it is believed advantageous to provide a seal assembly for a centrifuge bottle which minimizes or overcomes the generation and effect of the restorative force produced in the seal ring during the threaded engagement of the cap to the bottle. As a consequence, back-up of the cap with respect to the bottle is commensurately reduced.

SUMMARY OF THE INVENTION

In accordance with the present invention a seal assembly for use with the bottle and bottle cap of the type hereinabove described is provided which minimizes the restorative force imposed on the seal ring and thereby minimizes back-up of the cap with respect to the bottle. The seal assembly includes a generally annular seal ring and a slip ring arranged in stacked relationship within a seal chamber defined between the end of the bottle and the base of the groove. The seal ring is adapted to contact in sealed engagement with the end surface of the neck of the bottle while the slip ring contacts against the base surface of the groove in the cap. The annular slip ring is contoured to receive the seal ring in stacked relationship and is compressible into sealed engagement with both the seal ring and the cap. The slip ring is fabricated of a suitable material so that the slip ring is slidable with respect to the base surface of the groove against which it is in contact as the cap is threaded onto the bottle to thereby avoid the generation of a circumferentially directed restoring force in the seal ring.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be more fully understood from the following detailed description thereof taken in connection with the accompanying drawings which form a part of this application and in which:

Figure 1 is an enlarged sectional view of a seal assembly used in the Prior Art to effect a seal between a bottle cap and bottle;

Figure 2 is a side section view of a fixed angle centrifuge rotor illustrating the disposition of a capped bottle within the rotor;

Figure 3 is a sectional view similar to Figure 2 showing the seal assembly in accordance with the present invention; and

Figure 4 is a view similar to Figure 3 illustrating an alternate embodiment of the seal assembly in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Throughout the detailed descriptions similar reference numerals refer to similar elements in all figures of the drawings.

With reference to Figure 2 shown is a side view of a bottle B having a cap C threaded thereto. The bottle B is formed of a suitable plastics material such as polycarbonate or polypropylene, and is adapted to carry a sample of a material as that sample is exposed to a centrifugal force field. The cap C is typically formed from a suitable plastics material, such as polypropylene or glass-filled nylon. The bottle B is received in a cavity 12 provided on the periphery of a fixed angle centrifuge rotor 14. The fixed angle of the cavity 12 may range from vertical orientation to any conventional angular orientation with respect to the axis of rotation 16 of the rotor 14. A suitable sealed cover 18 is provided on the rotor 14. Of course, when the bottle B is received within a suitable adapter (not shown) the contents of the bottle B may be centrifuged in a swinging bucket rotor in accordance with established principles in the art.

As shown and discussed above in connection with Figure 1 a typical prior art seal arrangement which utilizes an annular elastomeric O-ring seal member S disposed in an annular chamber defined between the base surface of a groove G on the underside of the cap C and the top end surface of the neck N of the bottle B generates in the O-ring seal member S a restoring force while the cap C is threaded onto the bottle B. This restoring force acts on the cap C in a manner which tends to cause the cap C to back-up with respect to the bottle B. Since centrifugation of the bottle imposes high centrifugal force fields on the contents, it is important that the maximum sealed integrity be maintained between the cap and the bottle to minimize leakage.

In accordance with the present invention as shown in Figures 3 and 4 the seal assembly generally indicated by reference character 20 is disposed in the annular seal chamber E defined between the base of the groove G formed in the underside U of the bottle cap C and the upper end surface F of the neck N of the bottle B. The groove G is defined in the cap C by the downwardly extending flange K and a generally concentric inner wall W extending parallel thereto. As shown in Figure 3 and 4, respectively, the cap may be provided with threads H on either the inner surface of the flange K or the outer surface of the wall W with the bottle neck N having corresponding threads J on the appropriate surface. As noted earlier, the inner wall W may be defined by a plug received on the interior of the cap C. In this event, the threads H are provided on the inner surface of the flange K as shown in Figure 3.

The seal assembly in accordance with the present invention comprises a seal member 22 and a slip ring

24. The seal member 22 is preferably in the form of an elastomeric O-ring having a circular cross-section. Of course, the seal member 22 may assume any predetermined convenient configuration compatible for receipt within the seal chamber E in contacting relationship against the upper end of the bottle B. The seal member is preferably fabricated from a suitable elastomeric material, such as a fluorelastomer sold by E. I. du Pont de Nemours and Company, Inc. under the trademark VITON® or neoprene.

The slip ring 24 is an annular member formed of a compressible material adapted to receive and form a sealed abutment with the seal ring 22. The one surface 26 of the slip ring 24 that is adapted to abut in interfacial relationship with the base surface of the groove G in the cap C is provided with a shape in conformance thereto. Thus, since the base surface of the groove G is shown in the Figures 3 and 4 to be planar, the surface 26 of the slip ring 24 has a shape conforming thereto. Of course. this surface may assume any desired configuration with the surface 26 of the ring 24 being shaped in conformity thereto. The surface 28 of the slip ring 24 adapted to receive and abut the seal ring 22 is provided with a socket configured to receive the seal ring and is therefore shaped in conformance to the cross sectional configuration of the seal ring 22. Thus, in the figures, since the seal ring 22 is circular in cross section, the socket surface 28 of the slip ring 24 is hemispherical in shape to conform thereto. The seal ring and the socket surface 28 may, of course. assume any cross sectional configuration. The slip ring 24 is fabricated of material which does not grasp onto but is slidable with respect to the material of the base surface of the groove G in the bottle cap C. Pre-

ferably the slip ring is fabricated of a suitable plastics material, such as polypropylene or a fluorocarbon material such as that sold by E. I. du Pont de Nemours and Company, Inc. under the trademark TEFLON®.

In operation, the seal ring 22 and the slip ring 24 are arranged in stacked relationship within the seal chamber E defined between the base surface of the groove G in the cap C and the upper end surface F of the neck N of the bottle B. The surface 26 of the slip ring 24 contacts against the base surface of the groove G with the seal ring 22 abutting against the end of surface F of the bottle B. The seal ring 22 is received within the socket 28 in the slip ring 24. As the cap C is increasingly threaded in the right-hand threading direction T onto the bottle B due to the nature of the material used in the slip ring 24, the surface 26 thereof slides with respect to the base surface of the groove G against which it is contact to avoid the generation of a circumferentially directed restoring force in the seal ring. Thus the cap may be threaded securely to the bottom without the tendency of the cap to "back-up" due to the restorative force caused by torsion in the seal ring 22. Moreover, as the cap C is thus threaded onto the bottle B a compressional force acting in the direction of arrow P is exerted on the slip ring 24 and the seal ring 22. Compression of the seal ring 22 and the slip ring 24 seals the cap C to the bottle B.

Those skilled in the art, having benefit of the teachings of the invention hereinabove set forth may effect modifications thereto. It should be understood that such modifications are to be construed to lie within the scope of the present invention as defined by the appended claims.

WHAT IS CLAIMED IS:

1. In a seal assembly for a sample bottle for use in a centrifuge, the bottle being of the type adapted to receive in threaded engagement an inverted cup-shaped cap, the cap having an annular groove formed on the undersurface thereof, the threaded end of the bottle being extensible into the groove as the bottle and cap are threadedly engaged thereby to define a seal chamber therebetween, the improvement which comprises:

a seal assembly positionable in the seal chamber between the threaded end surface of the bottle and the base of the groove, the seal assembly comprising:

an annular seal ring adapted to contact in sealing engagement against the upper end surface of the bottle; and

an annular slip ring contoured to receive and compressible into sealed engagement with both the seal ring and the base surface of the groove when the cap is fully threaded onto the bottle, the slip ring being slidable with respect to the base surface of the groove against which it is in contact as the cap is threaded onto the bottle to avoid the generation of a circumferentially directed restoring force in the seal ring.

2. The seal assembly of claim 1 wherein the seal ring is circular in cross-section and the slip ring has a hemispherical socket on that portion of the ring which receives the seal ring.

3. The seal assembly of claim 1 wherein the slip ring is fabricated of a plastic material and wherein the seal ring is fabricated of an elastomeric material.

Fig.2.

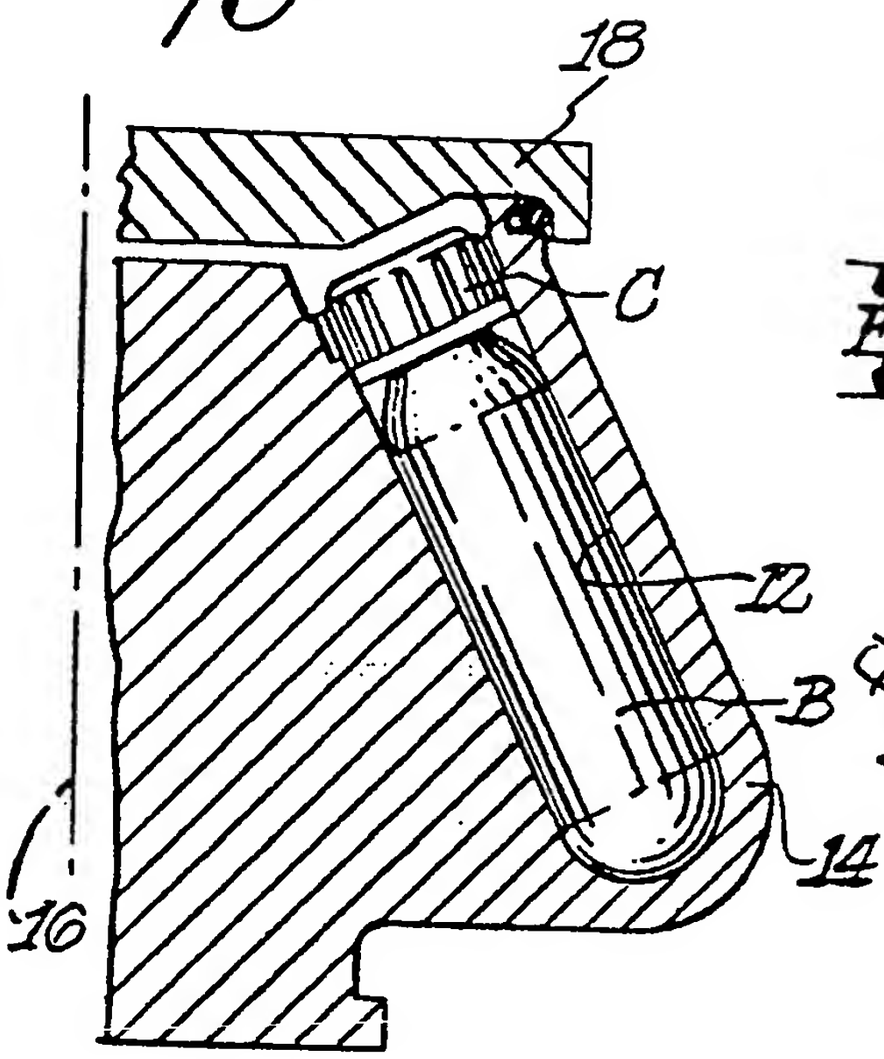


Fig.4.

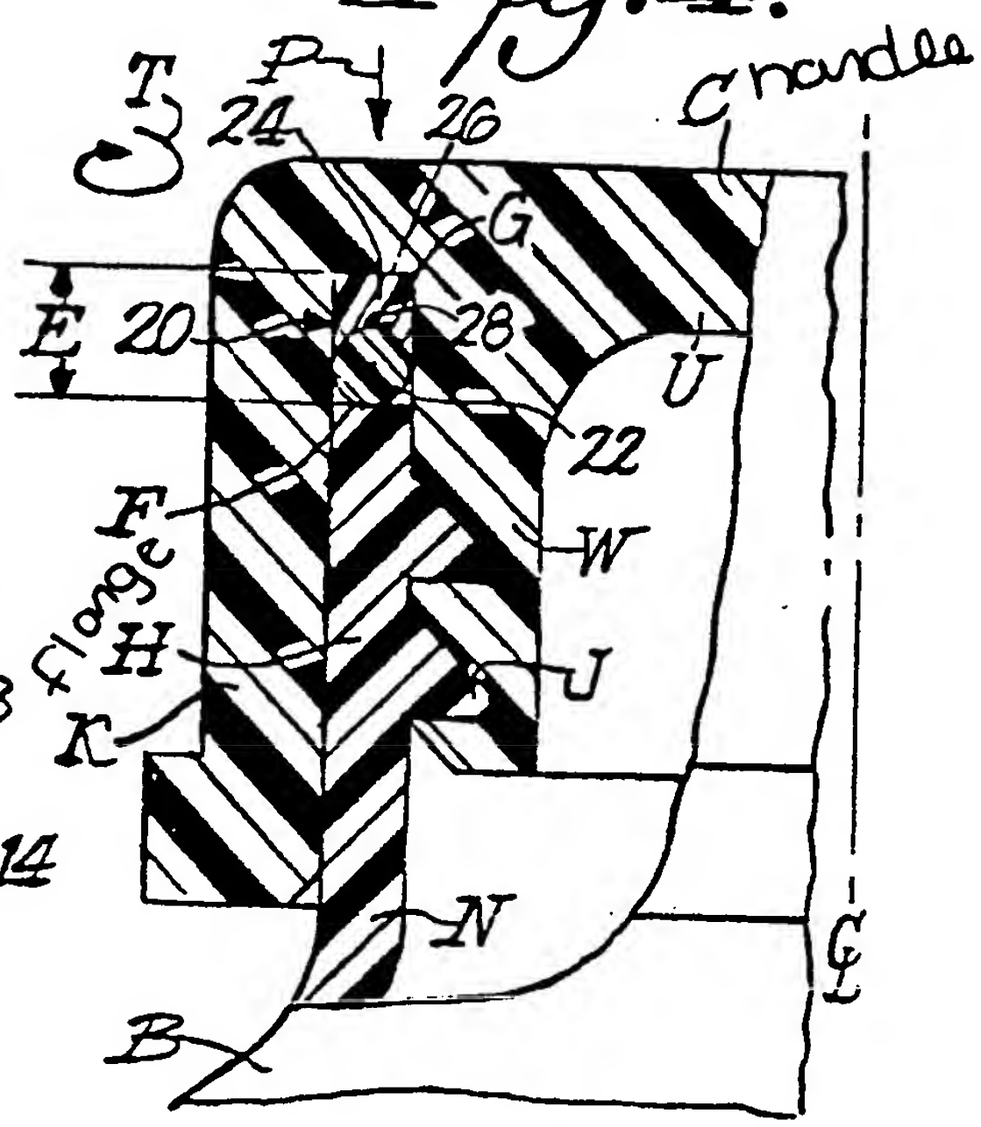


Fig.1 (Prior Art).

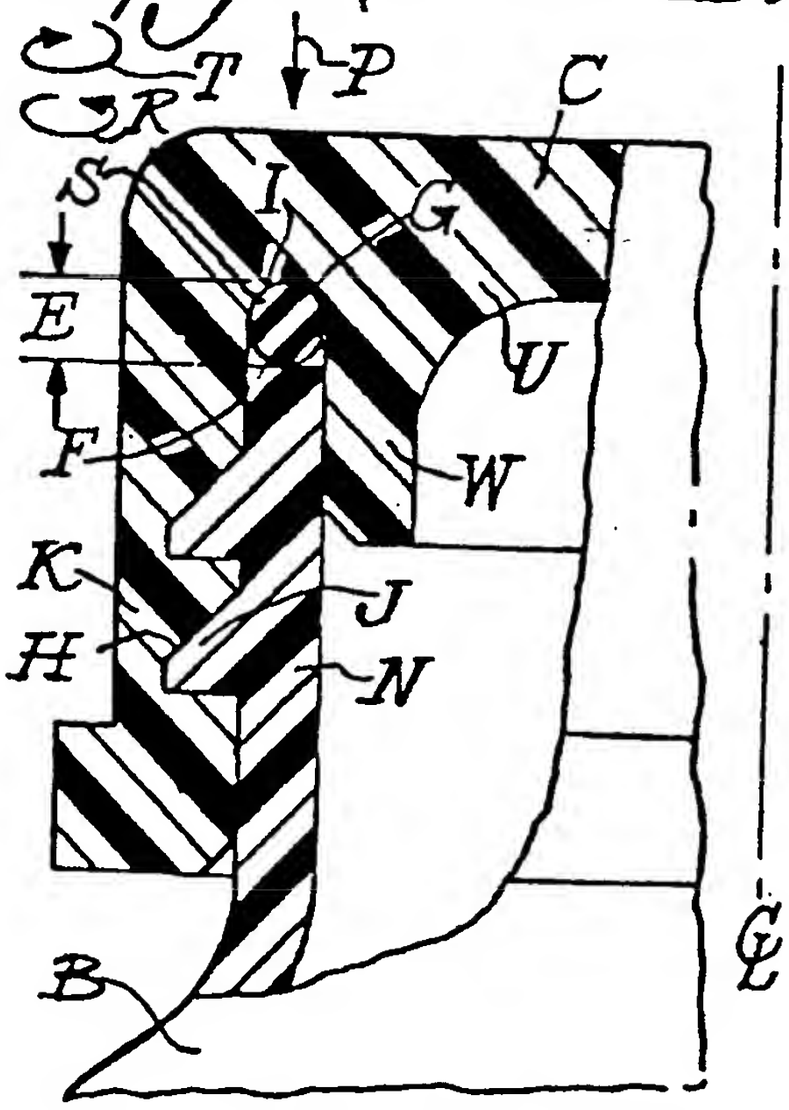
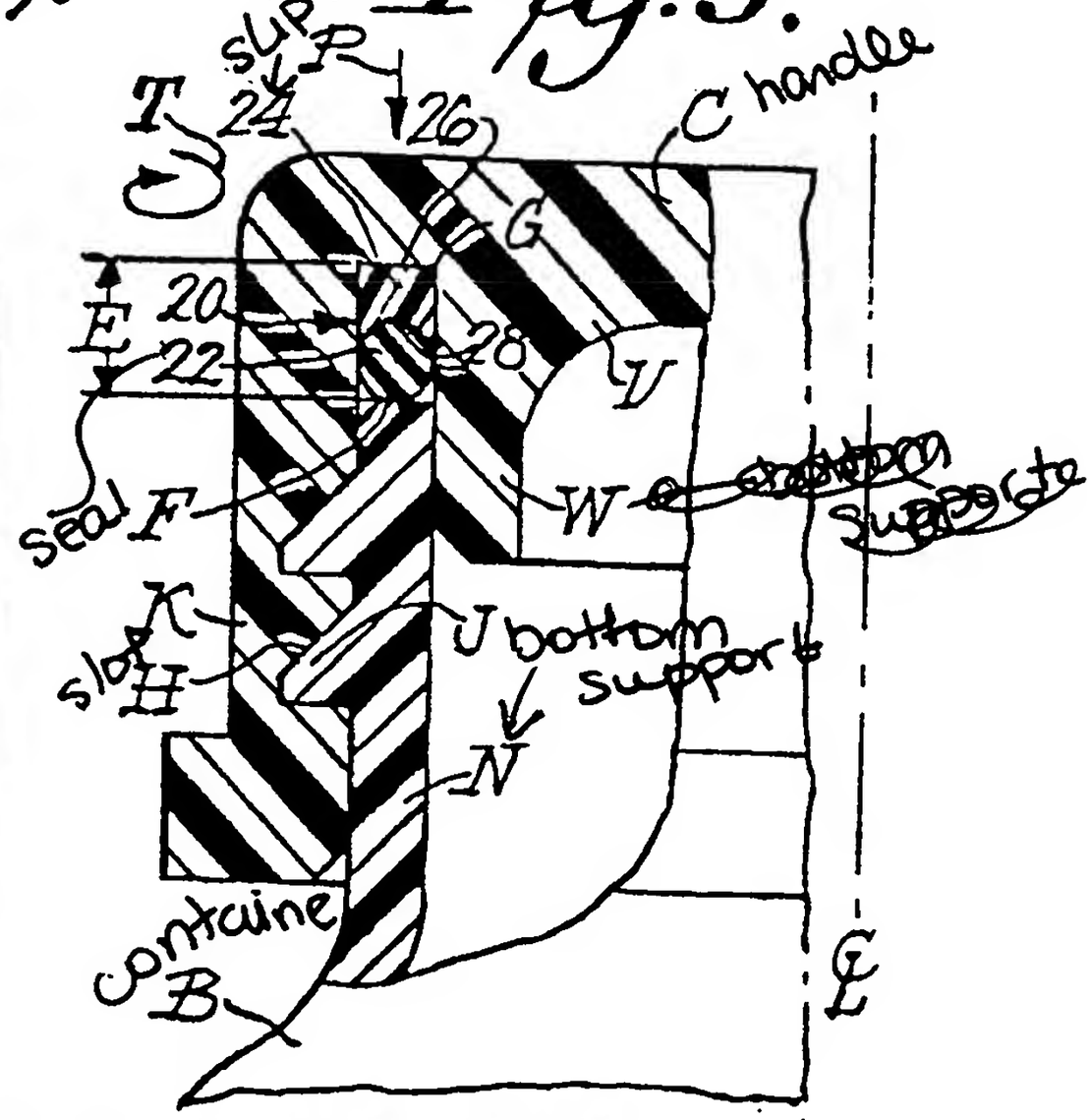


Fig.3.



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EUROPEAN SEARCH REPORT

0139289
Application number

EP 84 11 2386

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	GB-A-1 163 363 (BEIMERS) * page 1, lines 30-49; page 2, claim 1; figure 2 *	1	B 65 D 41/04
A		3	
A	GB-A-2 044 736 (YOSHINO)		

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

B 65 D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	17-01-1985	BESSY M.J.F.M.G.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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E : earlier patent document, but published on, or after the filing date
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